

Lepidoptera of different grassland types across the Morava floodplain

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Abstract. The occurrence of the diurnal and readily disturbed Lepidoptera species were studied during the 1992–1994 flight seasons on different types of grassland resulting from management practice: mowing, cattle grazing, and application of liquid manure. Observations were made across the southern part of the Morava River alluvia on 9 study sites. The transect method was used with 111 lepidopterous species in 15 families recorded. Five of these species are vulnerable and two species endangered. *Zerynthia polyxena*, *Iphiclides podalirius*, *Colias chrysotheme*, *Melanargia galathea*, *Minois dryas*, *Erynnis tages*, *Agriphila inquinatella*, *Loxostege sticticalis*, *Zygaena loti*, *Zygaena angelicae*, *Scopula virgulata*, *S. immutata*, *Idaea* spp., and *Euclidia glyphica* were associated with relatively well preserved xerothermic grassland habitats (no cutting history). *Heteropterus morpheus*, *Colias hyale*, *Lycaena dispar*, and *Maculinea teleius* associated with semi-annually cut and regularly flooded extensive wet meadows. *Psammotis pulveralis*, *Elophila nymphaeata*, *Coenonympha glycerion*, *Lycaena tityrus*, and *Phlogophora meticulosa* were found in bog habitat. The Lepidoptera community from the non-mown undisturbed areas with *Crataegus* sp. (forest-steppe vegetation) showed the highest diversity ($H' = 2.944$) and relatively high evenness ($e = 0.760$). The community from cut wet meadow that is heavily fertilized with liquid manure has both the lowest diversity ($H' = 1.036$) and evenness ($e = 0.383$).

INTRODUCTION

The Morava River forms the border between the Slovak Republic and Austria and partly between the Slovak and Czech Republics. The total length of the river is 353 km. In Slovakia the Morava River flows across the Borska Nizina lowland which forms part of the Pannonian region (Kulfan & Kulfan 1992). The lower reach of the Morava floods annually, usually in spring and often in summer after rainstorms. The territory where the field study was done, on the border near Austria, is relatively well preserved because it was inaccessible before 1990 (see map, Fig. 1). The study region is now part of the protected landscape territory Zahorie, where 1000 ha of inundation meadows are covered with the subcontinental plant association *Cnidion dubii* (Ruzickova, 1994). J. Kulfan (1989, 1990a, b) studied the lowland butterfly communities of Borska Nizina on irregularly cut meadows near the village of Rohoznik.

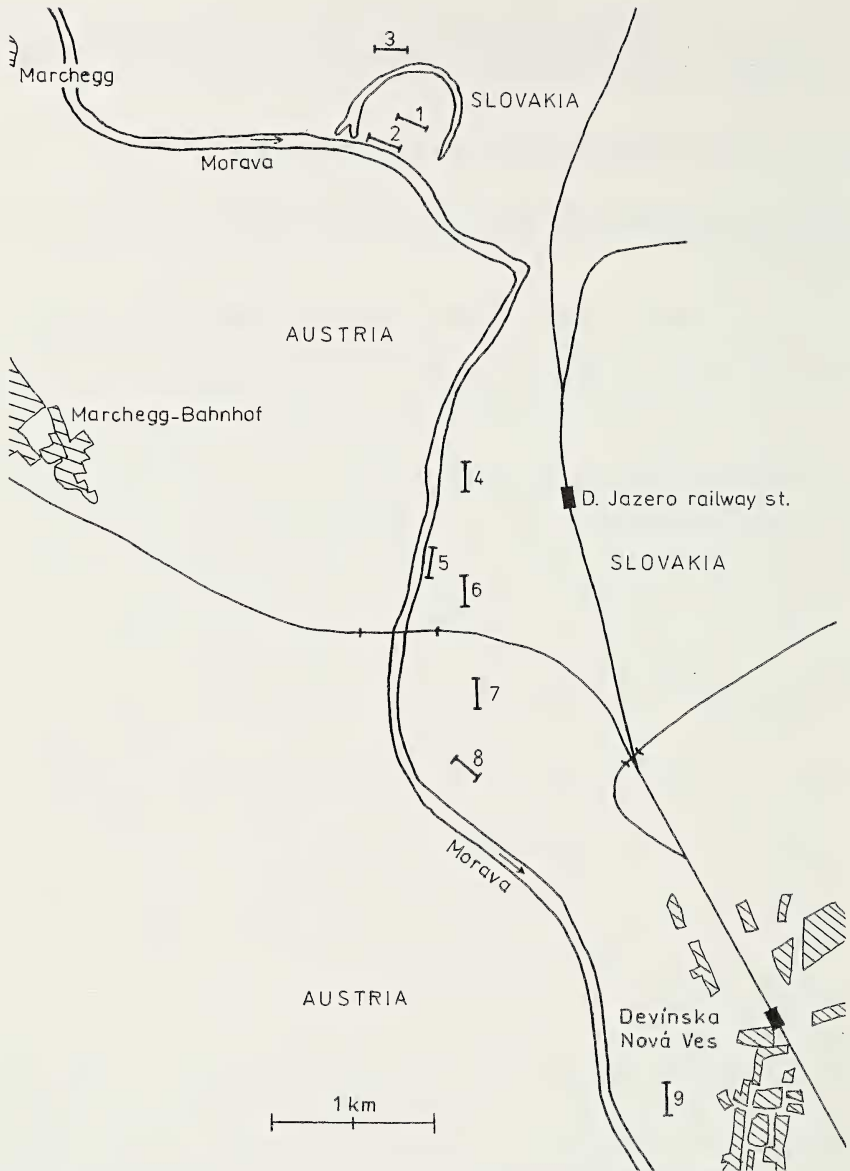


Fig. 1. Map of the lower Morava River showing approximate location of the sites used in this study.

The only data on the grassland Lepidoptera of the lower Morava River alluvia deal with the distribution of heliophilous species across Borska Nizina where these species were evaluated by trophic relations to host plants and from a conservation perspective (Kulfan & Kalivoda 1994).

The purpose of this paper is to compare the Lepidoptera communities across different grassland management regimes that vary according to cutting intensity, cattle grazing, and the application of liquid manure.

METHODS AND STUDY AREAS

Our investigations were carried out on the lower Morava River near a border between Slovakia and Austria during the flight seasons of 1992–1994 on sunny days at about 2 week intervals. Day flying and easily disturbed (roused) Lepidoptera were caught by net following the transect method of Erhardt (1985). The length of each transect was 200 m with 414 samples taken.

Nine sites were sampled:

Site 1: Alluvial meadow near Marchegg village cut twice and partly flooded during the annual cycle (*Carici praecoci-Alopecuretum pratensis* association, Spanikova 1975, subassociation *typicum* Bal.-Tul. 1963, with occurrence of *Iris sibirica*).

Site 2: Partly cut narrow area near Marchegg village along the field path, between *Prunus* and *Crataegus* shrub grove and the Morava river (*Carici praecoci-Alopecuretum pratensis*, subassociation with *Filipendula vulgaris* Bal.-Tul. 1974 with occurrence of *Aristolochia clematidis*).

Site 3: Alluvial meadow near Marchegg village cut twice annually and flooded regularly in spring and summer following heavy rains (*Carici praecoci-Alopecuretum pratensis*, subassociation *typicum* with occurrence of *Lychnis flos-cuculi*, *Iris sibirica*, *Iris pseudacorus*, *Clematis integrifolia*).

Site 4: Non-mown narrow area near the Devinske Jazero railway station between the path and the *Phragmites australis* stand (*Carici praecoci-Alopecuretum pratensis*, subassociation *typicum* with occurrence of *Aster lanceolatus* and *Clematis integrifolia*).

Site 5: Alluvial meadow near the Devinske Jazero railway station, usually partly mown twice annually with spring flooding, edged with *Phragmites australis* growth (*Lathyrus paluster-Gratiola officinalis* Bal.-Tul. 1963 and *Carici praecoci-Alopecuretum pratensis* associations, latter subassociation *typicum* with occurrence of *Thalictrum flavum* and *Leucojum aestivum*).

Site 6: Alluvial meadow cut twice annually, but rarely flooded (*Carici praecoci-Alopecuretum pratensis* association, subassociation *typicum* with *Colchicum autumnale*, *Galium verum*, *Symphytum officinale*, *Sanguisorba officinalis*, *Inula salicina*).

Site 7: Uncut area near Devinska Nova Ves (suburb of Bratislava) with the forest-steppe vegetation, *Crataegus* surrounded by agricultural phytocoenoses and by alluvial meadows (*Carici praecoci-Alopecuretum pratensis*, subassociation with *Filipendula vulgaris* and *Serratulo-Festucetum commutatae* Bal.-Tul. 1963 association on gravelly outcrops and sandy alluvial sediments with occurrence of *Galium verum*, *Sanguisorba officinalis*, *Inula salicina*, *Rumex acetosa*, *Centaurea jacea*, *Fragaria viridis*, *Aristolochia clematidis*).

Site 8: Alluvial meadow near Devinska Nova Ves, cut twice annually and partly flooded. Highly modified by application of liquid manure. There is a depauperate community of plant species (*Carici praecoci-Alopecuretum pratensis*, subassociation *typicum*).

Site 9: Alluvial meadow near Devinska Nova Ves modified by cattle grazing with a depauperate community of plants, partly flooded annually (*Carici praecoci-Alopecuretum pratensis*, subassociation *typicum* with *Galium verum*, *Rumex crispus*, *Cirsium arvense*).

The lower Morava floodplain was entirely flooded at the beginning of August 1991, with water level reaching about 2.5 m above ground elevation.

Table 1. General survey of Lepidoptera species found on the Morava River alluvia (EC = Ecological Characteristics: X = xerothermophil, M = mesophil, H = hygrophil, U = ubiquitous).

Taxon	EC	Study Area								
		1	2	3	4	5	6	7	8	9
Incurvaroidea										
Adelidae										
<i>Adela reaumurilla</i> (L., 1758)	M				2					
Tortricoidea										
Tortricidae										
<i>Aphelia viburnana</i> (D. et S., 1775)	M								+	
<i>Aphelia paleana</i> (Hb., 1793)	M								+	
<i>Agapeta zoegana</i> (L., 1767)	X						+			
<i>Olethreutes rivulana</i> (Sc., 1763)	M								+	
<i>Epiblema uddmanniana</i> (L., 1758)	X		+							
<i>Dichrorampha gueneana</i> (Obr., 1953)	X						+			
Pterophoroidea										
Pterophoridae										
<i>Pterophorus pentadactyla</i> (L., 1758)	X		2						+	
Pyraloidea										
Pyralidae										
<i>Hypochalcia ahenella</i> (D. et S., 1775)	X								+	
<i>Tachycera advenella</i> (Gm. et Znk., 1818)	X		+							
<i>Elophila nymphaeata</i> (L., 1758)	H			2						
* <i>Chrysoteuchia culmella</i> (L., 1758)	M						4	2	17	7 9
<i>Crambus pascuella</i> (L., 1758)	X, M								+	
<i>Crambus lathoniella</i> (Znk., 1817)	M								+	
<i>Crambus perlilla</i> (Sc., 1763)	M						4			4
<i>Agriphila tristella</i> (D. et S., 1775)	X, M								7	2
* <i>Agriphila inquatella</i> (D. et S., 1775)	X			2	2	2			7	2
<i>Platytes cerussella</i> (D. et S., 1775)	X								+	
* <i>Evergestis aenealis</i> (D. et S., 1775)	X			2						
* <i>Pyrausta despicata</i> (Sc., 1763)	X				2					
* <i>Loxostege sticticalis</i> (L., 1761)	X								7	4
<i>Ecpyrrorrhoe rubiginalis</i> (Hb., 1796)	X								+	
* <i>Sitochroa verticalis</i> (L., 1758)	X			4	9				7	4
* <i>Psammotis pulveralis</i> (Hb., 1796)	H					2				2
<i>Pleuroptya ruralis</i> (Sc., 1763)	X, M		2							
Zygaenoidea										
Zygaenidae										
* <i>Adscita statices</i> (L., 1758)	H									9
* <i>Zygaena loti</i> (D. et S., 1775)	X									4
<i>Zygaena viciae</i> (D. et S., 1775)	M								+	
* <i>Zygaena filipendulae</i> (L., 1758)	M									2
* <i>Zygaena angelicae</i> O., 1808	X									4
Hesperoidea										
Hesperiidae										
* <i>Erynnis tages</i> (L., 1758)	X, M		2						26	33
* <i>Pyrgus malvae</i> (L., 1758)	X, M	2	+						+	+
<i>Carterocephalus palaemon</i> (Pallas, 1771)	M, H								+	
<i>Heteropterus morpheus</i> (Pallas, 1771)	H				+					
* <i>Thymelicus sylvestris</i> (Poda, 1761)	M	4	+		2				13	4
* <i>Thymelicus lineolus</i> (O., 1808)	M	2	+		2			+	20	4
<i>Hesperia comma</i> (L., 1758)	M	2							+	
* <i>Ochlodes venatus</i> (Br. et Grey, 1853)	M		+						+	2

* <i>Idaea subsericeata</i> (Haw., 1809)	X							9
* <i>Idaea aversata</i> (L., 1758)	M							9
<i>Lythria purpuraria</i> (L., 1758)	X			2				
* <i>Lythria rotaria</i> (F., 1798)	X	4				7		4
* <i>Catarhoe cuculata</i> (Hufn., 1767)	X		4					
* <i>Epirrhoe alternata</i> (Müller, 1764)	X		4				+	4
<i>Minoa murinata</i> (Sc., 1763)	X			+				+
* <i>Lomaspilis marginata</i> (L., 1758)	M		4					+
* <i>Semiothisa clathrata</i> (L., 1758)	X		4	13	7		2	
* <i>Ematurga atomaria</i> (L., 1758)	X	4	+	2		7	9	13
<i>Siona lineata</i> (Sc., 1763)	X							+
Sphingoidea								
Sphingidae								
<i>Agrius convolvuli</i> (L., 1758)	X							+
<i>Macroglossum stellatarum</i> (L., 1758)	X							+
<i>Hyles euphorbiae</i> (L., 1758)	X							+
Noctuoidea								
Arctiidae								
* <i>Diacrisia sanio</i> (L., 1758)	X			2			+	2
<i>Syntomis phegea</i> (L., 1758)	X, M					+		
Noctuidae								
<i>Polygogon tentacularia</i> (L., 1758)	X							+
* <i>Euclidia glyphica</i> (L., 1758)	X							20
<i>Deltote bankiana</i> (F., 1775)	M, H							+
* <i>Emmelia trabealis</i> (Sc., 1763)	X					2		
* <i>Macdunnoughia confusa</i> (Stph., 1850)	X			2				2
* <i>Autographa gamma</i> (L., 1758)	X		+	2			7	4
<i>Phlogophora meticulosa</i> (L., 1758)	M, H							9
								+

RESULTS AND DISCUSSION

Table 1 presents the survey results of the Lepidoptera species found on the Morava floodplain. We have found 111 species in the region, but species not recorded during transect counts marked by a +. All the found species were used to construct the dendrogram of species similarity, using Soerensen's index following the Complete linkage clustering method of Podani (1993). The summary numbers of individuals of different species (68 species marked with an asterisk in Table 1) in the course of the periods 1992–1994 (27 samples from each site, 9 samples each year) were used for the Shannon and Weaver diversity and the Pielou equability (evenness) indices that are given in Fig. 2. The samples of Lepidoptera were from the same or similar date of each year with the differences between triplets of corresponding dates not exceeding 8 days.

Numerical classification according to species similarity shows that the Lepidoptera communities from non-flooded or rarely flooded sites with the plant community at drier elevations (sites 2, 6, and 7) form a separate group (Fig. 2). The community from the driest site (site 7) with forest-steppe vegetation has the highest diversity ($H' = 2.944$) and high evenness (equability) ($e = 0.760$). This corresponds with the high species richness on this site, 78 species (Table 1). The Lepidoptera communities of the damp sites (1, 3, 4, 5, 8, and 9) form a single group. Within this group the communities of sites 8 and 9, however, differ considerably from the others. They inhabit sites affected by negative anthropogenic factors, this is, intensively managed

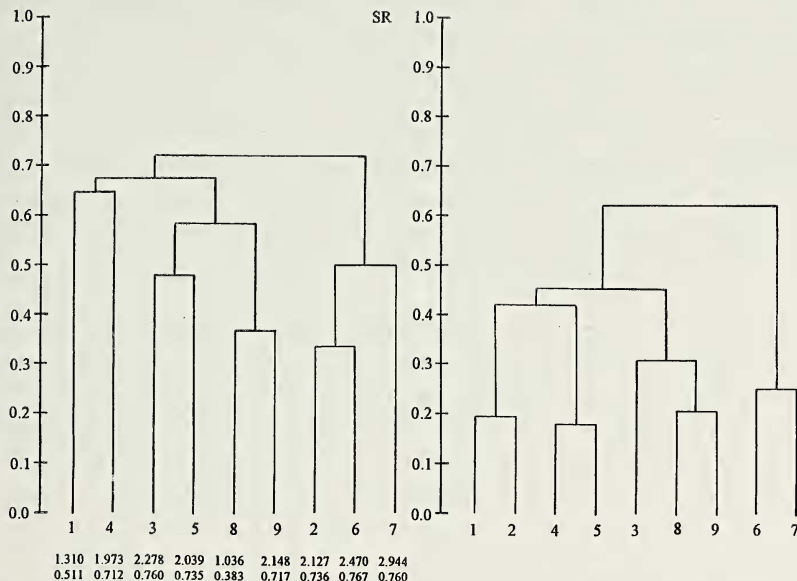


Fig. 2. Dendrograms of classification of Lepidoptera communities in individual study sites according to species presence/absence (to the left) and according to frequency of species (to the right). Diversity and equability values of these communities are given under the left dendrogram.

meadows. The community of Lepidoptera from site 8 with a depauperate plant community and application of liquid manure shows the lowest diversity ($H' = 1.036$) and evenness ($e = 0.383$). In contrast the community from site 9 with many ruderal flowering plants (*Asteraceae*) for food sources for adult butterflies has relatively high diversity ($H' = 2.148$) and evenness ($e = 0.717$).

The Lepidoptera communities of the more flooded sites, 3 and 5, form a distinct group. These communities have high evenness, $e = 0.760$ and 0.735 , respectively. Communities from sites with the same plant association (1 and 4) form another separate group, but are similar to each other at a low level (Fig. 2).

The hierarchical classification (Podani 1993; Fig. 2) used the Complete linkage clustering method and Similarity ratio index for making the dendrogram based on the frequency of 78 species (given in Table 1) which were derived from all 46 samples from each site.

The classification shows that the Lepidoptera communities of the driest sites, 6 and 7, form a conspicuous grouping (Fig. 2). The communities of the intensively managed meadows, sites 8 and 9, form a separate group together with the community of regularly flooded meadow, site 3. All these sites, 3, 8, and 9, are extensive open wet meadows without shrubs and trees. Lepidoptera communities of the narrow areas (1, 2, 4, and 5) surrounded by zones of a transitional character (e.g., shrubland) or by different habi-

tat type (e.g., banks, high *Phragmites australis* stands, etc.) form yet another separate group.

According to the IUCN classification, five of the species found are listed as vulnerable: *Heteropterus morpheus*, *Zerynthia polyxena*, *Iphiclides podalirius*, *Fixsenia pruni*, *Lycaena dispar*. In addition two species are listed as endangered: *Colias chrysotheme* and *Maculinea teleius*. *Zerynthia polyxena*, *Papilio machaon* and *Iphiclides podalirius* are protected by law. The greatest number of Lepidoptera occurred on site 7 where not only the xerothermic species occur, but many hygrophilous species immigrate from the nearby wet habitats as well.

According to an ecological classification of lepidopterous species given by Blab and Kudrna (1982), Koch (1984) and original data, the species spectrum shows that xerothermophilous species predominate in the investigated region (40.5%) (Table 1). This appears to be a result of the study region, altitude 138–145 m, with poor sandy soil, being located in the warmest region of Slovakia (Kulfan & Kulfan 1992). Some Lepidoptera found are known to prefer sandy soil, e.g., *Lythria rotaria*. Many butterflies, as *Minois dryas* and *Colias chrysotheme* fly to these sites from nearby habitats of xerothermic character with the forest-steppe vegetation, especially from the adjacent slopes of Devinska Kobyla, a part of Little Carpathian mountains.

The following species found in this study are useful indicators: *Zerynthia polyxena*, *Iphiclides podalirius*, *Colias chrysotheme*, *Melanargia galathea*, *Minois dryas*, *Erynnis tages*, *Agriphila inquinatella*, *Loxostege sticticalis*, *Zygaena loti*, *Z. angelicae*, *Scopula virgulata*, *S. immutata*, *Idaea* spp. and *Euclidia glyphica*. These species indicate relatively well preserved xerothermic habitats with forest-steppe vegetation characterized by *Crataegus* over uncut grassland on slightly elevated places as gravelly and sandy alluvial sedimentary outcrops, exemplified by site 7.

Heteropterus morpheus, *Colias hyale*, *Lycaena dispar*, and *Maculinea teleius* indicate extensive wet meadows, cut twice annually and frequently flooded, as site 3.

Psammotis pulveralis, *Elophila nymphaeata*, *Coenonympha glycerion*, *Lycaena tityrus*, and *Phlogophora meticulosa* indicate boggy habitats at sites 1, 3, 4, 5, and 9.

Two species from the family Nymphalidae, *Cynthia cardui* and *Aglais urticae*, reached their highest abundance on sites 8 and 9 that were modified by extensive application of liquid manure and by cattle grazing. The abundance of flowering weeds on site 9 especially attracted adults of these butterflies.

Acknowledgements. This research was supported by the Ministry of Education and Science, grant No. 1/990709/93 “Zoocoenoses of characteristic biotopes in surroundings of the rivers Danube and Morava” and grant No. 1/1141/94 “Conservation and Use of the Gene Pool of the Fauna of Slovakia.” We wish to thank two reviewers for valuable comments and Rudi Mattoni for final editing of the manuscript.

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